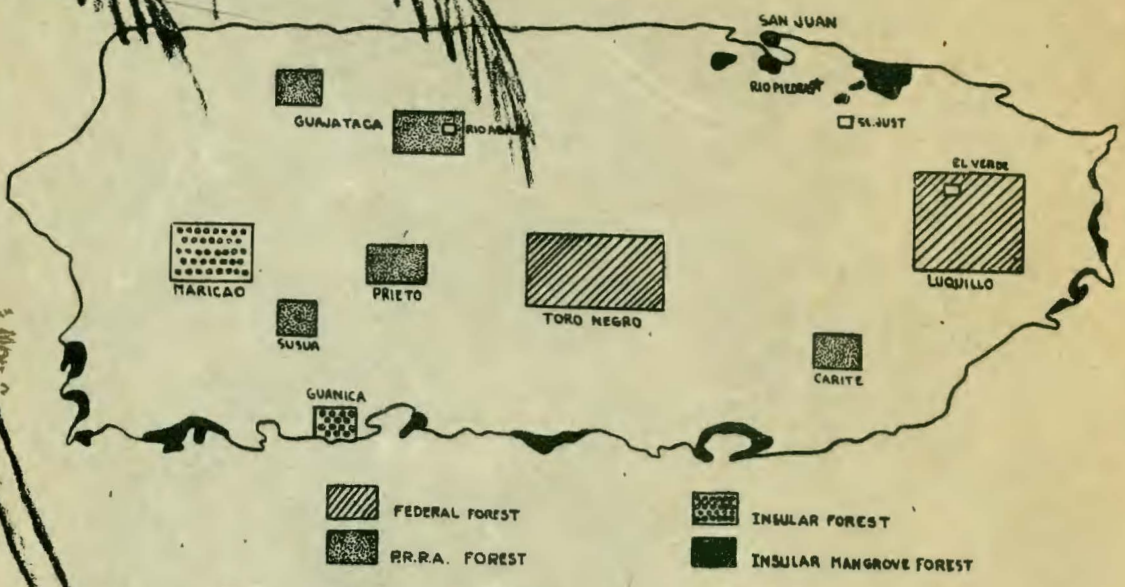
APPALACHIAN FOREST EXPERIMENT STATION

LIBRARY

# First Annual Report Tropical Forest Exp. Station

Arthur Bevan
Director




# Puerto Rico
1940

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Forest Type Map of Puerto Rico

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# FIRST ANNUAL REPORT
# OF THE
# TROPICAL FOREST EXPERIMENT STATION
# 1940

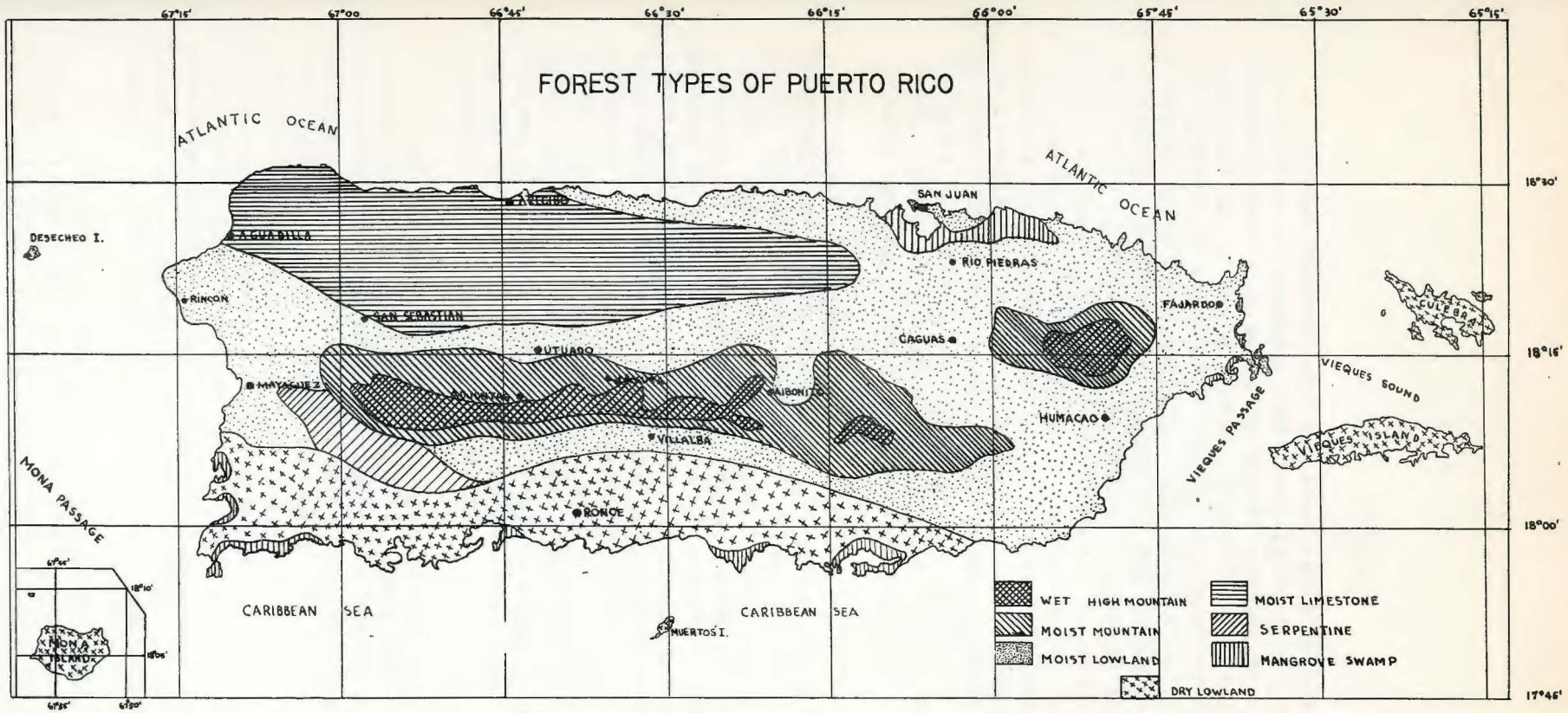
## FOREWORD

In writing the first Annual Report of this new Station we will review not only the work of the past year but something of the field that we are supposed to cover and also some of our hopes and expectations for the years to come. It is as though one forest experiment station had been established to cover the entire research field in continental United States and an area as large again. Primarily established to assist forestry in the American possessions, we are also charged with the duty to serve to the greatest possible extent all of the countries of Tropical America.

Is it any surprise that we are thrilled at the possibilities even if at times we are awed by the size of the task? With 600 endemic and exotic tree species in the island of Puerto Rico (130 miles long and 35 miles wide) the complexity of the problems involved can be imagined.

Our first year has been largely taken up with the organization and establishment of the Station and the collection of basic information and materials with which to work. While interesting and often an advantage, it is also a problem to start almost from scratch.

We are proud to join the family of Experiment Stations, and hope that with the coming years we will be able to show progress in keeping with the records and accomplishments of our older brothers to the North.




Note: Type names given are only general - further investigations are necessary before type designations and boundaries can be exactly defined.

## GENERAL

A new Station in a new field with problems practically untouched the program of research and investigation has had perforce to be largely an examination and study of forest conditions, past experience, and the accumulation of basic working materials. Literature on tropical forestry and species is distinctly limited and much of the territory is unexplored from the forestry viewpoint. New species are being discovered constantly. In Brazil, Venezuela, Colombia and the countries of Central America, and even those as well known as Haiti, Dominican Republic, and Guadeloupe, there are areas, often of vast extent, in which the forests are unexplored, their extent unknown, and their potentiality for the production of forest products unmeasured. Little or nothing is known about the growth of tropical species, an increment borer is of no value even in reaching approximations. First and foremost the primary job is a comprehensive problem analysis to start us on the right track and to help guide us in the years ahead. This has governed most of our work in the past year and will continue to be our main objective during 1941.

Most of us who are not familiar with tropical conditions visualize tropical vegetation and forests as an almost impenetrable jungle of lush growth festooned with vines and epiphetic plants of all kinds, the rain forest. While such jungles occur in many parts of the tropics such as portions of the Amazon River valley actually this is in no way general. We have to deal with variations of climatic conditions varying from sea-level to 19,000 feet which gives us the same range as though we traveled from the equator to the St. Lawrence valley in Canada with all the variations of flora one would expect to find on such a journey. While this is the extreme, a considerable area of the land mass involved is from 5,000 to 10,000 feet in altitude. Rainfall also varies from desert conditions with little or no rainfall to annual precipitation of between 200 and 300 inches. It is startling to find large areas where irrigation is essential to the growing of crops.

If you were to take a cruise to the tropics one of the first impressions you would get would be, where are all these tropical forests with unlimited resources in timber and wood products which we have heard so much about? They are not unlimited, although they are there, but you would not see them unless you took a trip into the back country. In the islands of the Caribbean with the exception of the Dominican Republic, Guadeloupe, Dominica, and Trinidad, no virgin stand remains worth mentioning and the forest has been replaced with brush, weed species, and some reproduction of valuable species. In the countries of the mainland there are vast savannah areas with little or no timber on which the grazing of live stock is a large and growing business.

In the populated areas which include all those you would see on a cruise, devastation is complete and little forest remains. Population density is large and the people ever pressed for a living push back into the hills where shifting agriculture (conuco farming) is practised with

all the attendant evils of soil erosion, loss of soil fertility, silting and floods. The economic and living conditions of these people are in many ways similar to the plight of the share cropper in the southeastern part of the United States and with slopes up to 75 and 80% placed under temporary cultivation they are often worse.

To cover such a wide field, research in every division should be carried on; Management, to protect and save existing stands, and to reestablish the accessible stands which have been destroyed. Influences, to assist water conservation for irrigation, to prevent silting of reservoirs for irrigation and hydroelectric power, and for flood control. Products to determine the use and value of tropical woods growing in the western hemisphere, of hundreds of species only the properties of a few are known. Economics, to survey and determine the forest resources of the tropics, to determine requirements for wood products in local and foreign markets, and to study the socio-economic problems on forest lands, so prevalent in tropical America. Range Management to improve the management and prevent destruction of the savannah and grazing lands which are surprisingly large and of sufficient economic importance to warrant extensive study.

With the Station's present personnel and limited finances this is not possible and if it is to fulfill the purpose for which it was established a rapid extension of work in all these fields should be provided for through increased funds and personnel.

## THE RESEARCH PROGRAM

You might well ask what is the Experiment Station doing to fill this field? Frankly, today we are opportunists tackling the most important and immediate problems which come to our attention but also studying the whole tropical problem and working to enlarge our forces to meet the challenge.

Because of current world conditions and the need for hemisphere solidarity every opportunity has been taken to meet with officials, to survey forest conditions and problems, in other countries, and to learn from their experience when possible. Visits have been made during 1940 to Cuba, Jamaica, Haiti, Santo Domingo, Virgin Islands, Guadeloupe, Martinique, Trinidad and the Canal Zone. We have had visitors from Venezuela and Colombia. Every possible opportunity will be taken for improving our knowledge of forest conditions and problems in tropical America. We plan to visit the countries of Central and South America in 1941. A cooperative project with Haiti is under way in the management and exploitation of their pine forests (Pinus occidentalis) occurring in the high mountains. Sustained yield is the aim, and excellent progress is being made.

In 1939 under the auspices and with the help of the Southern Forest Experiment Station, a quarterly publication "The Caribbean Forester", was started as a medium for the exchange of experience and knowledge between foresters and allied scientists. This publication has met with a splendid reception and manuscripts and articles from many countries have exceeded our fondest hopes. This quarterly publication has assisted materially in making the Station known and recognized in the field of tropical forestry.

## FOREST MANAGEMENT

Prior to the establishment of the Tropical Station, research had been started under the direction of the Southern Forest Experiment Station as a C.C.C. project. Research was aimed at solving problems arising from the large planting program being carried on by C.C.C. in the island. These experiments have been continued by the Station and will be carried to completion even though C.C.C. personnel was no longer made available for research work.

Seed Storage Studies.- In the tropics seed of all kinds deteriorates very rapidly and viability decreases in an astonishingly short time. With definite wet and dry seasons, planting schedules for maximum survival are clearly indicated and yet seed generally must be planted in the nursery as soon as collected or received. Correlation of nursery stock and planting schedules is generally not possible with the result that stock is either too big or too small at the best planting season, or planting is done at a season when a high percentage of loss is inevitable.

Cold storage and humidity control have shown highly significant results which in practically all cases will permit correlating nursery stock and direct seeding with correct planting schedules. So far the experiments have determined only per cent of germination and no attempt has been made to measure the effect of seed deterioration on vigor and rapidity of growth, an important factor because of extreme competition in the tropics and the high cost of weeding plantations.

Nursery Practice.- A study of methods being used in the nurseries has determined that in general the quality of stock for planting can be materially improved. Density in seedbeds is too great resulting in spindly stock seriously affecting survival. Studies will be continued to determine proper densities for the species being used in the planting program to be followed later by determinations of the best size and age of seedlings of different species for planting purposes.

Planting.- With the kaleidoscopic climatic, soil and altitude variations, and existing cover conditions in the island, appraisal of site to determine the most suitable species or mixture of species and method of regeneration is essential to successful establishment. Plantation failures, due to lack of knowledge of these factors and their effect on specific species, have been too frequent. A study of all plantations to date is under way to determine site factors, and their effect on survival and successful regeneration. Only a start has been made on this important project. We are already in a position to provide advice on some species but we are a long way from having all the answers. The planting program on the Island continues at a high level and we should be in a position to accelerate our work on this project so as to reduce the cost of plantations which is still too high despite all the improvement of technics to date.

Stand Improvement.- The problem of devastated forest lands covered with brush and some second growth is a large one. The forest problem on these lands is their restoration to productivity through thinning, weeding,

or other cultural treatment. Previous work has consisted only of observations and the preparation of technical instructions for the Caribbean National Forest for timber stand improvement operations. These were largely based on observations in stands previously worked over in T.S.I. operations. Some T.S.I. work was done in a young stand of 10 acres turned over to us by the Insular Agricultural Experiment Station as a woodlot. Plans are being prepared for T.S.I. experiments in more advanced second growth and hurricane wrecked coffee shade at the El Verde Branch Station. Stand improvement and regeneration projects are also planned at St. Just. With the older plantations approaching the time when thinnings are necessary, research to determine the best methods is needed. Adequate coverage of problems in this field will not be possible until additional personnel is available.

Growth and yield studies.- Little or nothing is known of the growth and yield of tropical species. Growth rings when present have no time significance in tropical species so that all growth figures must be obtained from plots or marked individual trees. Obviously growth and yield plots should be established as rapidly as possible in all important forest types and in connection with plantations. Because of the long period of time involved in such studies this should be done at the earliest possible date. In 1939, in cooperation with the Insular Forest Service, growth plots were established in young mangrove stands. These plots have been taken over by the Station, checked and reestablished. The absolute lack of such data and its value in a determination of the place of forestry in land use in the tropics gives such studies high priority. The deteriorated brush lands in the populated areas makes forest restoration of particular importance to the economic well-being and stability of the population.

Dendrology.- It must seem strange to some that there is still a considerable amount of work to be done in this field. Tree species are still being found and one new to science has been contributed by the Station. There is no manual or treatise on the trees of Puerto Rico and one is being prepared by the Station. So far, of the 600 known species, over 300 pen and ink sketches of leaves, flowers and fruit, have been completed. It is planned to publish these with descriptions orginally in multilith form in volumes of about 50 trees, later it is hoped that these can be edited, corrected as to taxonomic description where necessary and published in book form.

Started in 1938 and accelerated this year, a herbarium of dried specimens is being collected for identification purposes and as a source of material for taxonomic and ecologic studies. The Station herbarium now consists of around 800 mounted and identified specimens. This will be enlarged by collection or exchange to cover as completely as possible the tree species of tropical America. It will take a long time but that is our objective.

Forest ecology.- Silvicultural studies to limit and define the various forest types in Puerto Rico is needed as basic information in land use planning and regeneration. Our knowledge of site factors in relation to species distribution and associations is mostly limited to observations. A start was made in a preliminary study of the mangrove type but has not been followed up. There is a definite need for such basic information but work of this type must be delayed as finances and personnel are inadequate.

## FOREST ECONOMICS

There are many questions of economics which are fundamental to any problem analysis leading to a sound long range forest research program. Forestry is so integrated with agriculture in the hill lands of the tropics that the whole economic and social problem may well be dependent on a sound correlation of these two major types of land use. These problems include (1) the major one of shifting agriculture with its attendant soil erosion and loss of soil fertility, (2) the requirements of forest products for local use, very large amounts of lumber and other wood products are imported into Puerto Rico, (3) the forest resources of tropical America, about which there is so much speculation and so little is known.

Parcelero Study.- Because of the opportunity to do so the Station has touched on only one item in this field and then only a part of that involving shifting agriculture. The Forest Service in its acquisition of forest lands in Puerto Rico found itself with settlers and squatters, the hill people or "jíbaro", on their hands. The question was what to do with these people - to disposses them was unthinkable as they were born to the hills and mountains and had no other place to go. The British for years in their reforestation programs had used such people to regenerate the forest, this method is known as "Taungya". In Puerto Rico an adaptation of this method has been worked out whereby these people are resettled or permitted to stay on the land they occupied. They are used to replant the lands allotted them growing subsistence crops between the forest trees which are thus cultivated and protected from competition. This is known locally as the "Parcelero System", and differs from "Taungya" in that it is the intention to settle permanently these people on the parcel of land allotted to them. The plan is that they will eventually constitute the forest workers growing their subsistence crops either on a permanent plot or in rotation with forest trees and the cash income required to provide them with a fair living according to local standards will come from work in the forest or the manufacture of minor forest products such as charcoal, fence posts, stakes, etc. "Taungya" on the other hand, uses these shifting agriculturalists in the same manner up to the point of the establishment of a forest stand and then moves them to other areas to be reforested.

The parcelero system has grown up by a system of trial and error and has been the victim of constant changes of policy which has inevitably led to a feeling of insecurity by these people. Fundamental questions such as the size of the parcel which should be allotted, the cash income required to ensure a reasonable living, etc., have been answered without any basic data on which to make such determinations of policy.

At the suggestion of the Station, a cooperative project was started for a socio-economic study of the parcelero system. Statistics were collected in the field by means of a questionnaire which was filled in by the field force from answers given verbally by the parcelero - many of them cannot read or write. Tabulation and analysis of this data will give basic information on which policies can be predicated which should bring stability and security to these people.

We would emphasize the need for setting up of an economic division in the Station as fundamental to any research program. However carefully drawn no sound long range program of forest research will be established without the basic information which only economic studies can furnish.

## FOREST PRODUCTS

One of the chief considerations confronting forestry in tropical America is that of utilization. The diversity of species and the lack of knowledge in respect to the physical and mechanical properties of these woods is, therefore, of particular moment. The relative value and uses of at least the more important timber species must be known if management of tropical forests is to be placed on a sound factual basis.

The Station was, therefore, glad to enter into a cooperative project with the School of Forestry, Duke University, Durham, N. C. to make a series of tests of the mechanical properties of tropical woods. It is also proposed to include tests to determine the behavior of these woods to preservative treatments and thereafter to conduct durability tests both in the United States and the tropics. Observations will be made to determine the effect of seasoning and of different methods of drying. This is to be a continuing project and it is expected to test at least two species a year. For convenience, work will be started on the more important commercial species growing in Puerto Rico with the expectation that ultimately it will be extended to include other species endemic in other countries of tropical America.

## COOPERATING AGENCIES

In a climate where conditions are ideal the year round for the multiplying of insect pests and the growth of fungi any research program which ignored these factors would probably be courting disaster. The planting of Spanish cedar, a highly valuable species, has been entirely abandoned because of the destruction of plantations by a shoot borer. Recognizing this at the start the Station asked the agencies concerned to establish cooperative projects. The Bureau of Entomology and Plant Quarantine sent a technician to Puerto Rico to make an investigation of the field, and four months were spent in this work. Unfortunately because of lack of finances the Bureau was unable to follow this up by establishing an office here. The Bureau of Plant Industry has likewise been unable to do anything to date.

There is a very imperative need for an early start on forest insect and forest pathology research in the tropics which cannot be over emphasized.

## FARM FORESTRY PROGRAM

58% of the forest lands in Puerto Rico are found on farms according to the Census Bureau, 1935. Most of these lands are denuded or covered with brush of inferior or weed species. Fence posts, stakes, fuelwood, and charcoal are a necessity on all farms and a very large percentage of these products now purchased could be raised on farm woodlots. Possibilities for

forest farming are limited with the exception of the mangrove forests occurring in lagoons and salt marshes. Reasonable estimates indicate returns from fully stocked and managed mangrove stands of around $15 per acre per annum which might be considerably increased by higher utilization through such products as tanning extract and those of wood distillation. Coffee should be considered as a forest crop, also cacao in countries where it is grown. These crops are grown under tree shade and produce considerable amounts of charcoal from prunings. Vanilla is another crop which is grown in partial shade with trees for support and could be considered in the same category, particularly in view of its possible cultivation in connection with forest plantations during the early years of establishment. Farm forestry is of growing importance in the tropics and nowhere more than in Puerto Rico. Because it has the technical personnel, the Station is preparing a cooperative farm forestry plan for the island. This should lead to the establishment of a Farm Forestry Project under the Norris-Doxey Act.

## EDUCATION

Little or no educational work in forestry has been done in Puerto Rico, in fact the whole field of tropical forestry has been neglected. While some courses are offered at Yale University, no institution of higher learning covers the field. No books or pamphlets are available for use in local schools or for the general public.

The Station believes that if the results of its research work are to be of more than academic interest that a public appreciation of forestry must be built up.

There is in course of preparation a bulletin "Introduction to forestry in Puerto Rico" primarily for use in the schools and particularly for vocational schools of which there are 114 in the island. It will also be available for general distribution as it will be published in Spanish.

It is hoped that at a later date some courses in tropical forestry will be offered at the Insular College of Agriculture. Because of our desire to promote forestry education, it is possible that some of our personnel will participate by giving lectures to students. This might eventually lead to the establishment of a School of Tropical Forestry on the island which would collaborate very closely with the Station.

The bringing of students and persons connected with forestry programs from the countries of the Americas to the Station, for training in tropical forestry and research technics is one of our plans for the future, and provision is being made in our new building to take care of such students as well as to provide laboratory and office space for research workers in the biological sciences whose projects require work and study in the tropics.

## LIBRARY

One of the first activities of the Station was to accumulate all of the material and books obtainable dealing with tropical forestry and allied subjects. Publications which are out of issue and unobtainable will

eventually be bibliofilmed so as to make the library complete for reference purpose. We have been very successful in our quest and have received many valuable contributions and gifts from many countries for which we are most thankful. If any libraries have duplicates or publications dealing with tropical flora, forestry or other allied subjects that they do not particularly care to retain, they would be most gratefully received.

## W.P.A. PROJECTS

Faced with the need for the accumulation of basic working materials in a new field we were fortunate in obtaining approval of two E.R.A. and two W.P.A. (Insular) projects during the last half of the year. The two E.R.A. projects covered improvements to the El Verde Branch Station consisting of road improvements, landscaping, construction of trails, making furniture from native woods, and the construction of a forest guard house. One of the W.P.A. projects, approved in December provides additional funds necessary to complete the improvements at El Verde and similar work at the Rio Abajo Branch Station. The other W.P.A. project is a white collar project providing additional personnel for research projects in forest management, cataloguing and indexing our library, taxonomic pen and ink drawings of the trees of Puerto Rico, translations from English to Spanish of tree descriptions, herbarium mounting and cataloguing, collecting and making wood samples of tropical species found in Puerto Rico, breeding, collecting and, mounting specimens to form a collection of forest insects. The work performed by these relief projects has been invaluable as the Station was not in a financial position to carry on this type of essential work. Every effort will be made to continue the W.P.A. projects subsequent to June 30, 1941.

## PHYSICAL FACILITIES

### Branch Stations and Experimental Forests and Areas

In 1937 when the establishment of a Tropical Station was first proposed by the Forest Service, the Puerto Rico Reconstruction Administration approved the construction of buildings for research purposes and the buildings at the El Verde Branch Station (moist mountain type) and the Rio Abajo Branch Station (moist limestone type) were constructed. At the former Station a substantial concrete bungalow residence and a 3 car garage and servants quarters were constructed. It was the purpose to provide a combined field station and rest house for employees, the elevation being about 1,500 feet above sea-level, a very necessary adjunct in the tropics particularly for continentals. At Rio Abajo a residence and a combined office and sleeping quarters were completed. These branch stations are in process of improvement by means of the E.R.A. projects and when finished will be completely equipped for use. Experimental areas or forests must be set aside in connection with these stations and negotiations are under way with the Caribbean National Forest and the P.R.R.A. Forestry Division for the transfer of forest lands suitable for experimental purposes. At least one more experimental area should be established in the dry lowland type in the southwestern part of the island. This section is such a distance from headquarters that living and working quarters will be necessary when establishment of such a branch station is possible. In all probability an experimental area in the mangrove type will be found necessary in the

future program of the Station. Such an area can be found within easy distance of the main office at Rio Piedras.

The Puerto Rico Reconstruction Administration has recently transferred to the Station subject to the approval of the Secretary of Agriculture, 34 acres of rough hillside woodland and pasture at the St. Just Resettlement Area close to Rio Piedras. This tract of land is in the moist lowland type and typical of severely cut woods and abandoned farm lands scattered through the private and public lands of Puerto Rico. Such areas represent a potential source of forest products of considerable importance to the island if an economic means of bringing back such areas to productive forest can be found. The tract will be used for experiments designed to solve this problem and being readily accessible as a demonstration area it will contribute to the cooperative farm forestry program which is expected to be initiated soon.

Headquarters Office and Laboratory Building

At the time a decision was made to locate the Tropical Station in Puerto Rico, the Department of Agriculture and Commerce offered to sponsor a W.P.A. project for the construction of a building to house the Station. Plans were prepared for a monolithic concrete structure, hurricane and earthquake proof. The initial section was to cost $76,500. This was approved by W.P.A. and the Sponsor, and construction work was started in December 1939. Located on top of a hill in the grounds of the Insular Agricultural Experiment Station it has a magnificent view overlooking the city of San Juan and its harbor and an extensive vista of the island to the west. When completed the building will provide approximately 8,000 square feet of office and laboratory space. Although planned for expansion to twice this size, this will provide adequate facilities to house the Station for some years to come. While construction has been slowed down at times and the project has gone through many vicissitudes, it is expected to be ready for occupancy about June 1941. When this property is transferred to the Station, we will have quarters of which any one would be proud.

ACKNOWLEDGEMENTS

The Station has received a warm welcome and assistance from many sources both Insular and Federal. In particular it desires to thank the Department of Agriculture and Commerce for making possible the building we will occupy, the University of Puerto Rico for permission to build on the grounds of the Insular Agricultural Experiment Station, the Insular Agricultural Experiment Station for the temporary quarters furnished us even though currently crowded for space. To the Insular Forest Service, Puerto Rico Reconstruction Administration, the Caribbean National Forest and other agencies too numerous to mention we owe a debt of thanks for much of the progress we have made. The interest and cooperation shown by other countries of tropical America and the individuals who have contributed to "The Caribbean Forester" have been an inspiration to us. It is our hope that in the years to come we will be able to render service commensurate with the hopes and expectations of everybody and thus become a central institution for the encouragement and advancement of tropical forestry.

## PUBLICATIONS

October 1939 - December 1940


Bevan, Arthur.
Possibilities for forestry in the Virgin Islands: St. Thomas, St. John, St. Croix. Caribbean Forester Vol. 2 (1) 8. Oct. 1940.

Gregory, L. E.
Notes on the yarey palm of Puerto Rico and the straw industry derived from it. Caribbean Forester Vol. 1 (4) 13. July 1940.

Holdridge, L. R.
Forestry in Puerto Rico. Caribbean Forester Vol. 1 (1) 7. October 1939.

———
A rapid method of extracting balsa seed. Caribbean Forester Vol. 1 (2) 25. January 1940.

———
Calophyllum antillanum, a desirable tree for difficult planting sites. Caribbean Forester Vol. 1 (2) 27. January 1940.

———
The possibility of close cooperation for mutual benefit between agriculture and forestry in the American tropics. Caribbean Forester Vol. 1 (3) 25. April 1940.

———
Some notes on the mangrove swamps of Puerto Rico. Caribbean Forester Vol. 1 (4) 19. July 1940.

——— and Marrero, José.
Preliminary notes on the silviculture of big-leaf mahogany. Caribbean Forester Vol. 2 (1) 20. October 1940.

Marrero, José.
Conservación.
Caribbean Forester Vol. 1 (2) 17. January 1940.

Through the cooperation of the Southern Forest Experiment Station, who do the editing and multilithing, we continue issuing our quarterly publication "The Caribbean Forester". Volume 1, consisting of 4 numbers was completed with the October issue.

In addition to a large mailing list in the United States, "The Caribbean Forester" is mailed to interested persons and institutions located in:

Africa
Antigua, B.W.I.
Australia
Bahama Islands
Barbados, B.W.I.
Brazil
British Guiana, S. A.
British Honduras
Canada
Canal Zone, Panama
Chile
China
Colombia
Costa Rica
Cuba
Dominica, B.W.I.
Dominican Republic
Dutch Guiana
Dutch East Indies
El Salvador Republic
England
Fed. Malay States
Finland
France
French Guiana, S. A.
Germany
Grenada, B.W.I.
Guadeloupe, F.W.I.
Guatemala
Haiti
Hawaii
Holland
Honduras
India
Isle of Cyprus
Italy
Jamaica, B.W.I.
Martinique, F.W.I.
Mexico
New Zealand
Nicaragua
North Borneo
Norway
Panama Republic
Philippine Islands
Spain
St. Lucia
St. Vincent
Sweden
Switzerland
Trinidad, B.W.I.
U. S. S. R.
Venezuela

## STATION PERSONNEL

Tropical Forest Experiment Station
January 1, 1940 - December 31, 1940

### Overhead Administration:

Regular

| | |
|---|---|
| Arthur Bevan | Director |
| Ralph A. Shull (E.O.D. 2-1-40) | Jr. Administrative Assistant |
| Graciela Quintero (E.O.D. 5-6-40 S.S.T. 11-4-40) | Junior Clerk Stenographer |

Temporary (W.P.A.)

| | |
|---|---|
| Katherine A. Keelan | Librarian |
| Francisco Palacios Commelin | General Foreman, Grade 3 |
| Rosa Elena Quiñones | Accountant |
| Francisco León Alfaro Torres | Accountant |
| Abigail Hernández Rodríguez | Library Assistant |
| Elías Acosta Henríquez | Draftsman |
| Miguel Angel Cases Torres | Driver |
| Pelegrín Batista Figueroa | Driver |
| José Ramón Colón Rodríguez | General Foreman, Grade 1 |

### Forest Management:

Regular

| | |
|---|---|
| Leslie R. Holdridge | Associate Forester |
| José Marrero (E.O.D. 1-16-40) | Principal Biological Aide |
| Luis Enrique Gregory (E.O.D. 2-1-40) | Assistant to Technician |
| Ana Teresa Vega (E.O.D. 5-20-40) | Jr. Dictating Machine Transcriber |

Temporary (W.P.A.)

| | |
|---|---|
| José F. Pietri Ortiz | Artist |
| Ana María Vilá Balzac | Research Assistant |
| Carmen M. Otero Negrón | Research Assistant |
| Carmen Snow Solá | Research Assistant |
| Juan Emilio Lugo Rodríguez | Laboratory Assistant |
| Carmen de Cardi Roura | Research Assistant |

### Forest Economics:

Temporary

| | |
|---|---|
| Héctor Zayas Chardón (P.R.R.A.) | Chief Statistical Clerk |
| María Belén Capiel (P.R.R.A.) | Senior Clerk Stenographer |
| Efraín Díaz Cruz (Insular Forest Service) | Nurseryman |
| J. A. Dapena (Insular Forest Service) | Forest Inspector |

Although Congress appropriated funds for the entire fiscal year ending June 30, 1940, only Holdridge, assisted by Gregory and a stenographer furnished by C.C.C., was employed during the first six months. The work was directed by the Southern Forest Experiment Station, New Orleans, Louisiana, who were responsible for the C.C.C. research program which was carried on until the end of 1939.

While the Director, Arthur Bevan, was appointed December 16, 1939, he did not arrive in Puerto Rico until the 22d of January 1940. Actual organization of the Station began in February 1940 when Marrero and Gregory, research technicians and Ralph A. Shull, Administrative Assistant, were appointed. The W.P.A. and E.R.A. projects were finally approved and personnel was available in June.

January 14, 1941

## SILVICULTURE - STAND IMPROVEMENT

Field Division: Forest management.

Work Project: Silvicultural investigations.

Line Project: Stand improvement.

Purpose: To work out the best methods for improving volume and value increment in Puerto Rican natural and artificially regenerated stands through pruning, thinning, or other cultural treatment.

Review of past work: Previous work has consisted of observations alone and the preparation for the Forest Service of technical instructions for carrying out Timber Stand Improvement operations on the Caribbean National Forest.

Accomplishments during 1940: No formal studies were established during the year and work consisted simply of observations in stands previously worked over in T. S. I. operations.

Plans for 1941: Establish a formal study to determine the best method of thinning forest plantations of Calophyllum antillanum.

Date of completion: Indefinite.

Assignment: Holdridge and Gregory.

January 13, 1941

## DENDROLOGY - IDENTIFICATION

Field Division: Forest management.

Work Project: Silviculture

Line Project: Silvics - dendrological studies.

Purpose: (1) To preserve a collection of dried herbarium specimens of authenticated woody species as a reference for identification of unknowns brought in by Station or outside workers and as a source of material for taxonomic and ecological studies, and (2) to prepare an illustrated field manual of Puerto Rican trees for identification and study of living trees in the field.

Review of past work: Collections for the herbarium were begun in the spring of 1938 and at the end of 1939 about 250 specimens had been mounted and catalogued. One tree species new to science, included in this collection, was described by Monachino at the New York Botanical Garden. During the same period pen and ink sketches of leaves, flowers and fruit of 115 species, as well as 40 writeups were completed for the tree booklet.

Accomplishments during the past year: Collection in conjunction with field trips was continued throughout the year and the number of determined and mounted specimens was increased to nearly 1000. Identification of unknowns for the Forest Service and other organizations was continued throughout the year. Shipments of duplicate specimens were sent to the Department of Agriculture in Washington, the New York Botanical Garden and to the Arnold Arboretum Herbarium in Boston, Massachusetts. Two hundred new sketches for the tree booklet were completed and a total to date of 50 writeups were completed and translated into Spanish.

Plans for next year: Continue collection of specimens while on field trips. Continue tree booklet work and publish a set of 50 tree sketches and writeups.

Date of completion: The herbarium is a continuing project. The tree booklet will be spread out over several years.

Assignment: Holdridge and Gregory.

January 14, 1941

## SILVICULTURE - SILVICS (ECOLOGY)

Field Division: Forest management.

Work Project: Silviculture.

Line Project: Silvics (Ecology).

Purpose: To delimit, define, and study the various forest types in Puerto Rico as basic information needed in land use planning and regeneration.

Review of past work: In 1938, a study of the mangrove type was carried out and a set of preliminary notes on this type prepared and mimeographed for distribution. Also, a preliminary type map for the island was made up.

Accomplishments during 1940: No further study on this project was carried on during 1940 except for field observations in connection with other work.

Plans for 1941: Study and prepare preliminary notes on at least one more forest type.

Date of completion: Indefinite.

Assignment: Holdridge.

RS - TR
MENSURATION
Stand Studies

January 13, 1941

## MENSURATION - STAND STUDIES

Field Division: Forest management.

Work Project: Mensuration investigations.

Line Project: Stand studies.

Purpose: To determine growth, yield, and mortality in hardwood stands of Puerto Rico as a basis for intensive forest management.

Review of past work: In 1939, five plots were established in young mangrove stands in the San Juan Mangrove District of the Insular Forest in cooperation with technicians of the Insular Forest Service.

Accomplishments during past year: The plots were reexamined in the spring and because a certain amount of carelessness was evident in the establishment, tagging, and measurement of diameters, the plots were gone over completely and correctly reestablished.

Plans for next year: Extend this work by the establishment of additional plots in stands of other forest types.

Date of completion: Indefinite. The lack of exact time significance of growth rings makes it necessary to obtain all growth figures from plots or marked individual trees over a period of time.

Assignment: Holdridge and Gregory.

January 13, 1941.

## REGENERATION - PLANTING

Field Division: Forest management.

Work Project: Regeneration.

Line Project: Planting.

Purpose: To improve existing techniques or develop satisfactory new methods (1) for appraising sites to determine most suitable species or mixture of species, type of stock or seed, and method of regeneration to be used, (2) for attaining successful regeneration with desired species at the lowest cost of any stage in natural or deflected succession of the economically important forest types of Puerto Rico, and (3) for securing adequate protection from detrimental competition and mechanical injury by other vegetation during the critical period of establishment.

Review of past work: Studies to date have been largely exploratory and restricted to the more important tropical hardwood species. In 1938, a broad-leaf mahogany stock grade study and a few informals on debated questions of planting technique were set up as the start of forest research in Puerto Rico. This work, originally started as a C.C.C. project under the technical direction of the Southern Forest Experiment Station, was taken over by the Tropical Station at the time of its establishment in 1939.

Accomplishments during 1940: (1) Final reexaminations were made on the broad-leaf mahogany grade-stock study which has shown the much greater importance of site and site preparation over stock grades and also, that over-sized stock of this species, Swietenia macrophylla, up to 5 and 6 feet in height may be used satisfactorily by lopping the stems back to a length of from 12 to 18 inches. (2) An informal study to determine the effects of holding Montezuma speciosissima stock for various periods of time after lifting before planting, which was established in the autumn, has shown already a surprisingly greater survival of the stock held for 10 or 12 days over that planted immediately or in the first few days after lifting. (3) Unpublished information on the regeneration of Swietenia macrophylla and Calophyllum antillanum was assembled and published as preliminary notes on these species in the Caribbean Forester. (4) Preliminary rough examinations of previously established plantations on public forest lands indicated the close correlation of regeneration results of tree species with the soil types and physical conditions of the soils. (5) Study of regeneration methods in Trinidad and Jamaica

were made during visits to these islands and arrangements made for cooperation so that the Station may be informed of further developments in technique.

Plans for 1941: (1) Analyze the data and prepare formal reports of all studies completed to date. (2) Continue the study of regeneration methods for the five most important tropical hardwood species planted on the island. (3) Study the correlation of soil types and regeneration results with various species in established plantations as soon as the soil survey of Puerto Rico is made available.

Date of completion: Indefinite. After working out satisfactory methods of regeneration for the principal species, many other valuable hardwood species will be studied.

Assignment: Holdridge, Marrero, and Gregory.

RS - TR
REGENERATION
Seed Studies

January 14, 1941

## REGENERATION - SEED STUDIES

Field Division: Forest management.

Work Project: Regeneration.

Line Project: Seed Studies.

Purpose: To acquire sufficient information and develop satisfactory methods of collecting, handling and storage to supply seed in the best possible condition at any time for nursery and direct seeding requirements in Puerto Rico.

Review of past work: A seed storage study with five tropical hardwood species showed that viability of Swietenia macrophylla and Cedrela mexicana seed may be maintained satisfactorily over several months by storage at temperatures between 2° and 5° C. Recorded observations of flowering and fruiting dates were begun. A small trial of mechanical and acid scarification of Sideroxylon foetidissimum seeds to induce higher germination per cent was made.

Accomplishments during 1940: A second seed storage study of Montezuma speciosissima was carried out to determine the effects of maintenance of germination through control of both temperature and humidity. The two combined factors gave much better results than in the previous study with temperature control alone. Further records of flowering and fruiting dates were continued.

Plans for 1941: (1) Continue study of seed storage of Montezuma speciosissima with more exact control. (2) Develop better methods of germination tests. (3) Continue records on fruiting dates and set up criteria for judging seed maturity.

Date of completion: Indefinite.

Assignment: Holdridge, Marrero, and Gregory.

RS - TR
REGENERATION
Nursery

January 14, 1941.

## REGENERATION - NURSERY PRACTICE

Field Division: Forest management.

Work Project: Regeneration.

Line Project: Nursery practice.

Purpose: To develop satisfactory methods for the economical production and preparation for the field of planting stock suitable for regeneration requirements in Puerto Rico.

Review of past work: In the fall of 1938 and the spring of 1939, a depth of cover and type of cover material study was carried out with two sets of 10 species each of valuable tropical hardwood species. A few measurements of seedling growth in the nursery beds were taken.

Accomplishments during 1940: Growth measurements of a greater number of seedlings of several hardwood species were taken. Graphs plotted from these growth data show too great a density of stock for the production of satisfactory seedlings of the larger sizes.

Plans for next year: (1) Analyze data from the depth of cover and type of cover material study. (2) Study proper densities for the production of suitable stock of the more important species. (3) Study possibilities of rooting Magnolia splendens cuttings by stimulation with Hormodin powders. (4) Rewrite and bring up to date existing Nursery Manual in use by the Forest Service.

Date of completion: Indefinite.

Assignment: Holdridge and Marrero.

RP - TR
UTILIZATION
Mechanical properties
of tropical woods

March 1, 1941

## THE PHYSICAL AND MECHANICAL PROPERTIES OF TROPICAL WOODS

Field Division: Forest products.

Work Project: Strength of wood.

Line Project: Mechanical properties of tropical woods. A cooperative project with School of Forestry, Duke University.

Purpose: To determine the mechanical properties of the commercially more important tropical woods as a basis for determination (a) relative value of species, a primary factor in the management of tropical forests, (b) data for the establishment of correct strength functions or working stresses.

Review of past work: Commenced in September 1940.

Accomplishments during past year: Arrangements were completed for a series of mechanical tests on tropical species at Duke University to be collected and shipped by the Station. A working plan was completed.

Plans for next year: Collection and shipment of specimens of tabonuco (Dacryodes excelsa) with silvicultural data recorded in the field. Immediately on arrival at Duke University timber tests of this species will be commenced (tests will be confined to small clear specimens). The effects of drying, durability, and susceptibility to treatment with preservatives will also be tested. It is expected that at least two species will be tested annually.

Date of completion: Indefinite. Results for individual species will be published by Duke University as a cooperative project.

Assignment: Bevan and Gregory in cooperation with Professor Harrar, School of Forestry, Duke University.

RE - TR
PUBLIC DOMAIN
Parcelero Study

March 1, 1941

## PARCELERO SYSTEM: TO DETERMINE THE FINANCIAL AND ECONOMIC STATUS, ECONOMIC SIZE OF PARCEL, AND OTHER FACTORS AFFECTING THE SOIL AND ECONOMIC WELFARE OF THESE SETTLERS

Field Division: Forest economics.

Work Project: New public domain.

Line Project: Parcelero system. A cooperative project with the Insular Agricultural Experiment Station, Puerto Rico Reconstruction Administration, and Insular Forest Service.

Purpose: A preliminary socio-economic study of the parcelero system of settlement on public forest lands mainly to determine financial and economic status of settler, economic size of parcel, and other factors affecting the social and economic welfare of these settlers.

Review of past work: Begun in 1940.

Accomplishments during past year: Work was commenced in August 1940. Field data on 436 parcelero families was collected (approximately 50% sample) restricted to those established on the land for more than one year and allotted a parcel 3 acres or more in extent. Field work completed in December 1940.

Plans for next year: Tabulation and analysis of the data collected. Write-up of study for publication.

Date of completion: July 1, 1941.

Assignment: Bevan, in cooperation with Descartes (Insular Agricultural Experiment Station), Zayas Chardón (Puerto Rico Reconstruction Administration), Dapena and Díaz Cruz (Insular Forest Service).